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An Introduction to the Bradley Conduct of Fire Trainer: A Videotape

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The videotape described in this report was designed to be used as introductory classroom material for students receiving Bradley Fighting Vehicle (BFV) Conduct of Fire Trainer (COFT) gunnery training. The COFT, a computer-driven high fidelity precision gunnery training device, is of sufficient complexity that a standardized pretraining film was needed to orient students before hands-on instruction. This report details the rationale for and contents of the videotape and provides a copy of the script.

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This report provides the rationale for and contents of a videotape created for institutional Bradley Fighting Vehicle gunnery training. The project is part of an overall mission to assess instructional strategies and technologies to improve weapon system training. Sponsorship for Bradley research has been provided under a 1983 Memorandum of Understanding between the Training Technology Agency at TRADOC, the U.S. Army Infantry School, and the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI).

The videotape was designed to be used in conjunction with other training materials for students who are receiving Bradley Conduct of Fire Trainer (COFT) Instructor/Operator (IO) or Senior Instructor/Operator training. The COFT is a computer-driven, high fidelity precision gunnery training device. The IO receives a 46-hour block of instruction on the device during a course offered by the Fort Benning, Georgia, Bradley Instructor Detachment. The videotape was developed at the request of and in close coordination with the 29th Infantry Regiment, 1st Battalion, Bradley Instructor Detachment, and is in use in institutional Bradley COFT IO training.

ACKNOWLEDGMENTS

AN INTRODUCTION TO THE BRADLEY CONDUCT OF FIRE TRAINER:
A VIDEOTAPE

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AN INTRODUCTION TO THE BRADLEY CONDUCT OF FIRE TRAINER:
A VIDEOTAPE

INTRODUCTION

As resources available for military training become
scarce, gunnery simulators, devices, and training aids have
assumed an increasingly important role in assisting mechanized
forces in achieving and maintaining gunnery readiness. Fuel
and ammunition costs are increasing, and the competition for
live-fire ranges puts training time at a premium. Without
additional methods of training critical gunnery skills,
personnel may have difficulty in acquiring or maintaining their
necessary skills within limited time and resources.

The most widely fielded precision gunnery training device
presently available for mechanized units is the Conduct of Fire
Trainer, the COFT. Effective use of the COFT provides a
partial solution to the problems of diminished resources,
increased costs, and a continuing demand for highly trained
soldiers. The COFT is a computer driven, high fidelity
precision gunnery trainer developed for the Army by General
Electric's Simulation and Control Systems Department. The COFT
has versions for the M1 and M60A3 series tanks and for the
M2/M3 Bradley Fighting Vehicle, and each can be updated to
reflect changes in equipment and tactics or techniques.

The Unit Conduct of Fire Trainer (U-COFT) is found in
units world-wide. It was designed to be used in any of four
modes. It can provide basic training for beginning gunners or
transition training for personnel with some related prior
experience. It is also used for cross training personnel who
are familiar with the system, but are not yet experienced with
the turret weapons.

Finally, and most effectively, the U-COFT is used as a
unit sustainment trainer for trained crews in home station
training. It can be used for diagnostics, to determine a
crew's readiness, or to ensure that a crew reaches minimum
proficiency before it is permitted to live fire. It can be
used for train-up; to prepare crews for an approaching gunnery.
Finally, the U-COFT is used to complement live-fire training to
ensure that no crew or individual gunner loses his skills
through lack of practice. Certification achieved in the U-COFT
does not correspond to a training goal as measured by the
traditional Table VIII qualification found in gunnery manuals;
it indicates only that the crew has engaged targets under a
variety of conditions, and has met prescribed U-COFT standards.
Since the system can keep or store crew records for an

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indefinite period, when a soldier changes units, his performance data can be transferred with him.

The Institutional Conduct of Fire Trainer (I-COFT) was designed for gunnery training at the Armor and Infantry Schools. It provides tutorial and practice exercises for the novice, and runs through a self-paced program of instruction to teach basic gunnery. Specific skills are demonstrated, practiced and tested, under the guidance of an instructor. The Mobile Conduct of Fire Trainer (M-COFT) is used by National Guard units. It is a self-contained U-COFT housed in a trailer. When transported from site to site, the M-COFT becomes a mobile gunnery training center.

This paper focuses on the Bradley COFT system, and Bradley gunnery training. It is intended to provide the background and rationale for a COFT pretraining videotape which was filmed for use in institutional training courses.

Description of the COFT

The COFT has several functionally distinct components. One section contains computers which provide exercise scenarios and store and manage data. The crew station replicates the commander and gunner's positions, and with a very few exceptions, is identical in appearance and function to the BFV turret. An instructor/operator (IO) sits at the instructor operator station (the IOS or IO station) to conduct training. The IOS has two color monitors which replicate what the commander and gunner see in their sights and a situation monitor which indicates upcoming targets, type and location. A keyboard and terminal printer enable access to the system and data entry.

The Instructor/Operator

The IO is the key to COFT training. Before a session, he prebriefs the crew by discussing the prior lesson and previewing the upcoming training. Using computer printouts from previous sessions, he reminds the crew of errors, or special techniques which need to be practiced in the day's training. The IO monitors the ongoing gunnery. As a target appears, is located, identified and engaged, the situation monitor reflects the crew's performance. Since he sees an image of the gunner's reticle on the screen, the IO can help the crew acquire targets and assist in scanning, tracking, gun lay, lead, aiming point, etc. The IO can freeze an exercise to give guidance, or can stop and restart the exercise.

At the conclusion of each exercise, a performance analysis shows how well the crew did on the exercise, and indicates specific errors. After training, the IO provides a debrief,

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analyzing crew performance and recommending practice before the next session. The IO can select specific exercises for the crew to fire, based on unit standard operating procedure or on his expert judgment, or he can have the crew progress according to computer recommendations. With proper feedback from a well trained IO, the crew members learn their gunnery strengths and weaknesses, and the benefits of the device are maximized.

Targets, Graphics, and Visual Effects

The COFT provides computer imagery targets in simulated tactical scenarios. Single or multiple (no more than two) targets are presented in frontal, flank or oblique aspects, fully exposed or in partial defilade. Targets are stationary or moving at speeds from 0 to 40 miles per hour. They appear at ranges from 460 to 3320 meters in a gaming area which is a 3 by 6K piece from a 7 by 10K European terrain data base. Friendly target models are the M1 and M60A3 tanks, and the BFV. Threat vehicles include the T72 tank, the BMP personnel carrier, the HIND-D helicopter, and a truck. Dismounted troops are simulated by flashes to represent small arms fire. Additional targets and a desert database will be available soon.

Sounds of weapon fire and the visual effects of bullet or missile impact are shown. All turret weapons are represented but tracer burn time and obscuration from missile firing are not entirely realistic. The computer generated color graphics provide sufficient fidelity for a crew to be able to see terrain features such as grass, hills, distance lines, and the horizon. Graphics show sheds, barns, trees, rocks, hedgerows, and water.

Gunnery Exercises and Scoring

Gunnery training progression and exercise selection is based on the COFT training matrix, represented by a three dimensional block which shows exercises and their relationships. The currently used BFV library has 300 exercises for the commander and gunner firing as a crew, 84 exercises for the commander only, and 17 special purpose diagnostic and introductory exercises. Movement in the matrix is based on a computer algorithm which grades gunnery performance and recommends the next exercise based on that performance. The computer graded assessment enables a crew to progress at its own pace toward its own goals.

COFT exercises are graded in three areas. Target acquisition (TA) refers to the day or night visibility levels. Unlimited visibility is clear, with no distractions. Limited visibility shows targets at dawn or dusk. The most difficult level, battlefield conditions, has friendly and enemy fire

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visual distractions. TA scoring is based on how quickly the crew acquires and identifies the target. Penalties are given for errors in identification or classification, for firing at non-targets, firing at friendly targets, or failing to fire.

Reticle aim (RA) level is another area scored. RA indicates the difficulty of the engagement, whether the BFV and targets are stationary or moving, and the number and characteristics of the targets. Reticle aim is scored according to the time for the crew to fire the first round or burst, and the time to kill the target. In missile firing, the magnitude of error, distance from center mass, is also scored.

Exercise difficulty is dependent on target number, range, and evasiveness, and on the operational capability of the equipment. Some exercises have stabilization failure, or unannounced malfunctions. Others require the crew to be masked as if in a Nuclear, Biological, Chemical (NBC) environment. Still others require firing in manual mode or use of the auxiliary sight. Many exercises include friendly targets to help insure proper target identification.

The third area, system management (SM), covers crew coordination as represented by switch setting errors. Errors are incorrect ammunition selection, failure to go to high magnification, and defilade errors when the BFV remains exposed too long. Failure to have the driver move up or back is also penalized.

The Problem: Institutional Use of the COFT

The COFT is used in Bradley gunnery training in the school environment, as an adjunct to the hands-on experience gained on the actual vehicles in dry fire, subcaliber, and full caliber range firing exercises. However, in the institution with necessarily short programs of instruction (POIs), only limited COFT time is available. When personnel being trained have strong BFV backgrounds (e.g., master gunner students), the COFT is a familiar device, and crews use it as a complement to their other training without preliminaries. However, for the gunner's course or for the commander's course, most students have had little or no prior Bradley training. When the POI calls for introduction to COFT firing, the typical student has had no previous experience with the COFT.

The COFT is a complex system with many capabilities and limitations. However, the typical initial classroom introduction provides an overview which tends to confuse rather than help the student. Some materials may be presented too quickly; others receive more or less attention depending on the interests and abilities of the instructor presenting the

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information. Some material is given in more detail than is
needed for the introductory student; other potentially useful
information is not given.

Repeated observations of classroom presentations and
subsequent student behavior in the COFT suggested that a
standardized pretraining session would reduce confusion and
would provide positive training benefits. Previous films had
been discarded because of outdated material and errors.
Accordingly, it was decided that a new videotape should be made
to help introduce the COFT. As a familiarization film, it
would stand alone to provide information and preliminary
training. Its film medium would insure uniformity of
presentation, and complete coverage of the relevant
information. Additionally, use of a video in the classroom
would help accustom students to the COFT graphics before
firing. This in turn would insure more efficient use of the
actual in-trainer time.

Additional benefits of such a standardized overview of the
COFT are apparent. Precommand courses, somewhat tailored to
the individual, are typically very short, and intensive, and
may provide only minimum familiarization for an individual
preparing a BFV command. A filmed presentation on the major
BFV gunnery device would insure a new commander's awareness of
this valuable resource. Excerpts could also be used for
briefings when the device is not available.

PROCEDURES

A preliminary videotape outline was written, and the
material was discussed in detail in a group session with the
senior COFT IOs in the Bradley Instructor Detachment (BID) at
Fort Benning. Over the course of a week, using two video
cameras, ARI and BID COFT personnel filmed specific exercises
and U-COFT training sessions. Some taping was done when actual
student groups were in the COFT to insure that a variety of
military personnel served as IOs. Other training sessions or
incidents were staged to insure that specific situations were
covered.

Fifteen complete exercises of varying difficulty were
filmed to provide material for the final tape. All three
levels of target acquisition, and varying degrees of engagement
difficulty were shown. Some night and auxiliary sight
exercises were filmed, and each kind of target model was
represented on the tape. Additionally, interior views of the
COFT were provided to show equipment, briefings, and personnel
at the IO station. A mock fire alert was staged to show
procedures to be followed in the unlikely event of a fire in
the trainer. Based on the original outline, a narration was

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written to go along with the visual scenes. (See Appendix A for the actual script.)

RESULTS AND DISCUSSION

The finished product is a 15 minute videotape entitled "An Introduction to the Bradley COFT." It provides a short, systematic and standardized introduction to COFT training. Intended to replace existing outdated or inadequate materials, this tape was designed to permit natural stops for teaching specific techniques, with a sequence tailored to a new gunner or COFT user.

The narration describes the visually pictured computer shelter, the crew briefing/monitoring area, and the instructor operator station, delineating functions and some safety precautions. The crew station interior is shown, with a description of the ways in which it does and does not replicate the BFV turret. Specific target models and terrain features are shown, as are typical engagements to familiarize a student with the COFT capabilities. The film shows what targets look like when hit, what happens when a round falls short, and the effects of firing. Sector scanning is shown, together with general techniques of engagement for single and multiple targets from both stationary and moving BFVs, in day and night conditions. Scoring rules are included. The background audio track provides proper fire commands to reinforce the correct procedures being shown on the screen. In sum, as planned, the videotape provides a comprehensive introduction to the COFT.

CONCLUSIONS

The final tape serves several purposes within Bradley training courses. It provides a standardized pretraining lesson to prepare novices for their first COFT training sessions. While introducing the student to the philosophy and purpose of the COFT, it also exposes them to the COFT graphics and specific rules of engagement. The standardized presentation reduces potential errors, improving the quality of instruction. The student going to a unit to become a Bradley commander or gunner more fully comprehends the purpose of his COFT training. For the new platoon leader, platoon sergeant, or company or battalion commander, the film highlights the importance of the COFT and the gunnery training benefits to be accrued by proper use of this valuable resource.

APPENDIX A

AN INTRODUCTION TO THE BRADLEY COFT - SCRIPT

The Conduct of Fire Trainer, the COFT, is a computer driven, high fidelity gunnery trainer, developed for the Army by General Electric.

It has three versions: the institutional I-COFT used in training schools, the mobile M-COFT used by the National Guard, and the unit U-COFT, found in Bradley units world-wide.

The COFT helps crews achieve and maintain skills between gunneries. It provides computer imagery targets in tactical scenarios. The kind and number of targets vary, as do visibility conditions and level of difficulty of the exercise.

The COFT can be used at any level of gunnery starting with basic. For cross and transition training the COFT speeds the process and saves both range time and ammunition. Primarily, however, the COFT is a sustainment trainer.

It can be used for diagnostics, to determine where a particular gunner or crew falls in readiness. It can be used to insure that a crew reaches minimum proficiency before it is permitted to go to live fire. It can be used for train up, to prepare a crew for an approaching gunnery. Finally, the COFT is used in support of live fire training to insure that no crew or individual gunner loses his skills through lack of practice.

Certification in the COFT does not correspond to a training goal as measured by Table VIII; it indicates that the crew has engaged targets under a variety of conditions, and has met set standards. The COFT can keep or store crew records indefinitely. When a soldier changes units, his COFT data can be transferred with him.

COFT targets are frontal, flank or oblique, stationary or moving, either fast or slow. Sounds of weapon fire and the visual effects of bullet or missile impact are shown; all turret weapons are represented but tracer burn time is not realistic.

Computer generated graphics provide enough fidelity for a crew to be able to see terrain features such as grass, hills, distance lines, and the horizon. Graphics show sheds and barns, trees, rocks, hedgerows and water.

Friendly target models are the M1 and M60A3 tanks, and the BFV. Threat vehicles are the T72 tank, the BMP personnel carrier, the HIND-D helicopter and a truck.

There are also dismounted troops, simulated by flashes to represent small arms fire. Exercises also show manual mode and NBC conditions, selected malfunctions, and use of the auxiliary sight.

In the COFT, the gunner uses the ISU, the auxiliary sight or the unity window; the commander looks through the ISU, the aux, or his front periscope. Targets appear at ranges from 460 to 3320 meters, and are stationary or move at speeds from 0 to 40 miles per hour. The gaming area is a 3 by 6K piece from a 7 by 10K European terrain data base. A desert data base and additional targets will be available soon.

The Unit Conduct of Fire Trainer is a stand alone shelter. One section has computers which provide scenarios and store and manage data.

The training shelter has a remote monitor area where crews awaiting training can watch other crews fire. The remote area has two screens that provide a view of the action. An additional instructor can assist. The remote area can also be used for briefings.

The crew station is identical to the BFV turret with a few exceptions. The COFT operates only in closed hatch mode, the thermal knob does not work, there is no gun elevation pointer/mil scale, TOW reload requires maximum elevation, and for safety, the intercom functions even when the turret power is off. The COFT, unlike the BFV, has in-use sensors to tell the computer which sight is being used.

The Instructor Operator (IO) sits at the Instructor Operator Station, known as the IOS or IO station. The IO is the key to COFT gunnery training.

During the session, he monitors crew gunnery performance. He can freeze the exercise to give guidance or he can stop it and start over.

The situation monitor indicates upcoming targets, type and location. As a target appears, is located, identified and engaged, the situation monitor reflects the crew's behavior. It shows who has control of the turret and keeps a running record of the crew's performance.

At the end of each exercise, a performance analysis shows how well the crew did, and indicates major errors.

The IOS has two color monitors which exactly replicate what the commander and gunner see. The IO can help them acquire targets and assist in scanning, tracking and gun lay. The IO sees the gunner's reticle and can evaluate lead, aiming point, etc. At the end of the session, the IO can play back the exercise. Finally, the IO prints hard copies of crew records. He also critiques at the end of each exercise.

The IO also makes written notes to assist in the debrief. With proper feedback, the crew learns strengths and weaknesses, and the benefits of the device are maximized.

Before conducting training, the IO prebriefs the crew. He discusses the last session and previews the upcoming session. After training, he gives a debrief, analyzing performance and recommending practice before the next session.

COFT gunnery is based on the training matrix, a three dimensional block which shows COFT exercises and their relationships. Movement in the matrix is based on a computer algorithm which grades gunnery performance and recommends the next exercise based on that performance. This permits a crew to progress at its own pace toward its own goals.

COFT exercises are graded in three areas. Target acquisition refers to the day or night visibility levels. Unlimited visibility is clear, with no distractors. Limited visibility shows dawn or dusk.

The most difficult level, battlefield conditions, has friendly and enemy fire visual distractions. Target acquisition scoring is based on how quickly the crew acquires and identifies the target. Penalties are given for errors in identification or classification, for firing at non-targets, firing at friendly targets, or failing to fire.

Reticle aim level is another scored area. Reticle aim indicates the difficulty of the engagement, whether the BFV and targets are stationary or moving, whether targets are single or multiple, and the mix of vehicles.

Reticle aim is scored according to the time it takes the crew to fire the first round or burst, and the time to kill the target. In missile firing, the magnitude of error, distance from center mass, is also scored.

The final area, system management, includes crew coordination as represented by switch setting errors. Errors are selection of incorrect ammo, failure to go to high magnification, and defilade errors when the BFV remains exposed too long. Failure to have the driver move up or back is penalized.

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The COFT has safety precautions. In the unlikely event of fire, an audible alarm sounds; all personnel must exit the shelter immediately. Halon fire extinguishers are set off.

No one should tamper with controls, electric panels or sensors or enter the COFT shelter without an IO. No food, drink or smoking is permitted, the shelter must be kept clean, and crews wear CVC helmets.

Since the COFT is air tight, the air conditioners must be on at all times, for constant temperature and to insure proper air exchange.

What you see next are some excepts from training sessions.

After a safety briefing, the IO reviews the last session, previews the day's training. The crew enters the turret and the IO starts the exercise by reading the instructions.

Gunnery simulators, devices, and training aids are increasingly important as competition for range time increases, as fuel and ammunition cost increase, and crews cannot acquire or maintain skills with limited time and resources. The COFT, the most powerful gunnery device available to a Bradley crew, is a potential solution to these problems.

Let's take another look at that friendly!